

ACCELERATION

A change in velocity (Δv) occurs when the speed of an object changes, or its direction of motion changes, or both. Changes in velocity can be either positive or negative. To find a change in velocity, subtract the initial velocity from the final velocity.

$$\overset{\rightarrow}{\Delta v} = \overset{\rightarrow}{v_f} - \overset{\rightarrow}{v_i}$$

North, east, up, and right are considered positive (+) and south, west, down, and left are negative (-).

If you are travelling forward at 6m/s and you increase your velocity to 9m/s, your change in velocity is as follows:

$$\begin{aligned}\overset{\rightarrow}{\Delta v} &= \overset{\rightarrow}{v_f} - \overset{\rightarrow}{v_i} \\ &= +9\text{m/s} - (+6\text{m/s}) \\ &= +3\text{m/s}\end{aligned}$$

Your change in velocity is 3m/s in the forward direction. You are speeding up by 3m/s. Your initial forward direction is positive, so your change in velocity is positive when you speed up.

If you slow down from 9m/s forward (positive) to 2m/s forward (positive), your change in velocity is as follows:

$$\begin{aligned}\overset{\rightarrow}{\Delta v} &= \overset{\rightarrow}{v_f} - \overset{\rightarrow}{v_i} \\ &= +2\text{m/s} - (+9\text{m/s}) \\ &= -7\text{m/s}\end{aligned}$$

Your change in velocity is 7m/s opposite the forward motion. You have slowed down by 7m/s. Your initial forward direction is positive, so your change in velocity is negative when you slow down.

If you were travelling at a constant velocity, your initial and final velocities would be equal. Therefore, the change in velocity for that time interval would be zero. Any object travelling with uniform motion in a straight line would have zero change in velocity.

ACCELERATION is the rate at which the velocity of a moving object changes. A change in velocity can be a change in either speed or direction. Thus, acceleration occurs when the speed of an object changes, or its direction of motion changes, or both. Acceleration is a rate of change. This means it also takes into account how quickly the velocity changes.

When comparing the acceleration of two objects, the object with the greater acceleration changes its velocity in a shorter time interval or has a great change in velocity during the same time interval.

Recall that forward motion is defined as positive and backward motion is defined as negative. Different factors help you decide if an object's acceleration is positive or negative, as shown in the table below.

FACTOR	VELOCITY	ACCELERATION
Increase in speed while travelling forward, eg. accelerating after you have stopped at a stop sign	+ (positive)	+ (positive)
Decrease in speed while travelling forward, eg. applying the brakes on a bicycle	+ (positive)	- (negative)
Increase in speed while travelling backward, eg. a car increasing its speed going backwards	- (negative)	- (negative) velocity changes from -1m/s to -4m/s, change in velocity would be -3m/s
No change in speed, eg. running at constant speed	Constant	0

Note that an object that is slowing down is changing its velocity: therefore, it is accelerating. If the acceleration is in an opposite direction to its velocity, the object's speed decreases. Acceleration in a direction that is opposite the direction of motion is sometimes called **deceleration**.